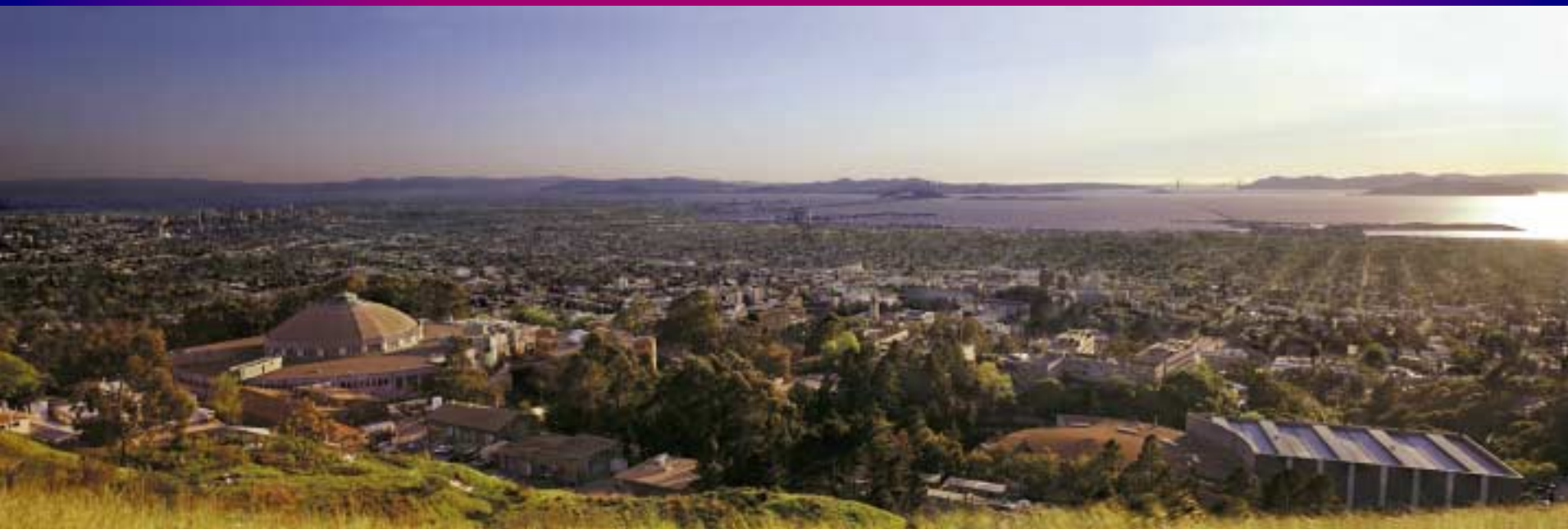


# **Presentation to IEST: WG036 – Fan-filter Unit Testing Testing Procedure for FFUs’ Energy and Aerodynamics Performance**



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# Presentation Outline

## ◆ LBNL Past & Current Work

- Wide Collaboration
- Funding – Scopes
- Goals
- Collective Input

## ◆ Activities/Accomplishments

- Draft procedures and reviews
- Methods
- Results
- Industry acceptance

## ◆ Key Issues

- Additional parameters – uniformity, leak, acoustics
- Airflow rate measurements
- FFU positions
- Baseline

## ◆ Recommendations to/from IEST

# LBNL Past Work

- ◆ ITRI/AMCA/Suppliers involvement
  - ◆ Need: Unbiased, Third-party Standard
  - ◆ IEST involvement
- 
- ◆ Funding Awarded to LBNL for FFU development and incentive program

# Current Work

## – Industry Collaborations

- ◆ Sematech
- ◆ Silicon Valley Manufacturers Group
- ◆ ITRI (Industrial Technology Research Institute, Taiwan)
- ◆ Air Movement and Control Association (AMCA)
- ◆ ASHRAE
- ◆ IEST (minienvironment, fan-filter units)

# Current Work

## – Funding (Scopes)

- ◆ California Energy Commission
- ◆ Industrial Technology Research Institute (ITRI)

Scopes

Energy/Airflow perspective

# Current Work

## - Goals

- ◆ Issue a standard test procedure. FFU's performance can be measured by the standard test and will have a basis for "apples to apples" comparisons and owner specification.
  - Focus on energy/airflow while IEST is developing a more comprehensive procedure
- ◆ Assist utility in using the procedure to establish baselines for incentives

# Current Work

## – Collective Input to LBNL project

### ◆ Suppliers

- Filtration Group, Envirco, Huntair, Cleanpak, Airguard, ...
- + You

### ◆ End-users

- Bayer, Asyst Technologies, Motorola, Intel
- Consultants – Air Tech Intl., Rumsey
- Utility

### ◆ Third-parties

- AMCA/ITRI
- PAC – LBNL/CEC
- IEST Contamination Control Division
- Sematech

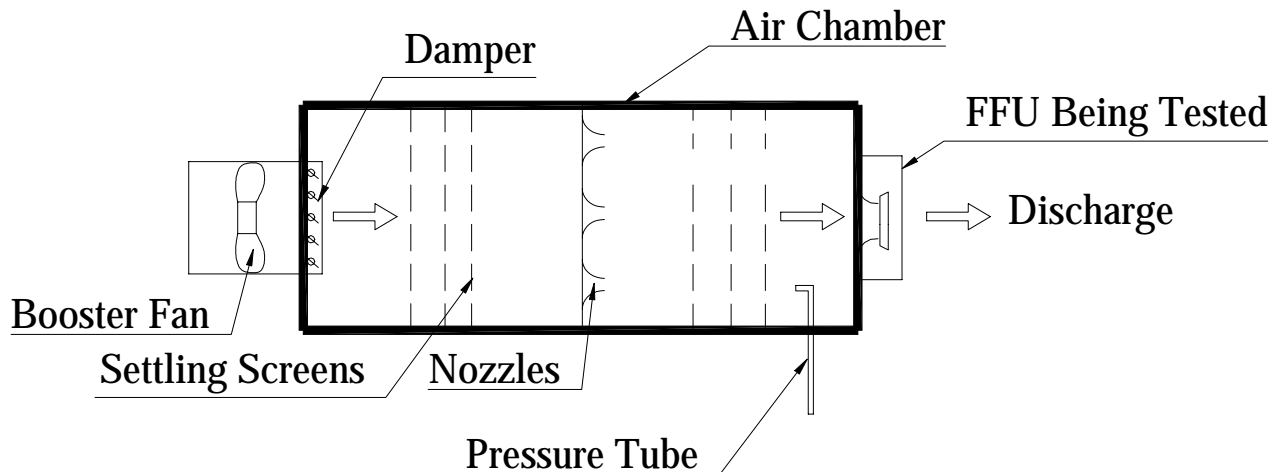
# LBNL Activities/Accomplishments

- ◆ Attended the first IEST WG36 meeting in November 2003
- ◆ Issued procedure drafts
  - An outline for comments in January 2004
  - 1<sup>st</sup> draft for comments in February 2004
  - 2<sup>nd</sup> draft for comments in April 2004
- ◆ Received supportive review comments
- ◆ Planning PAC meeting in May 2004



# Methods

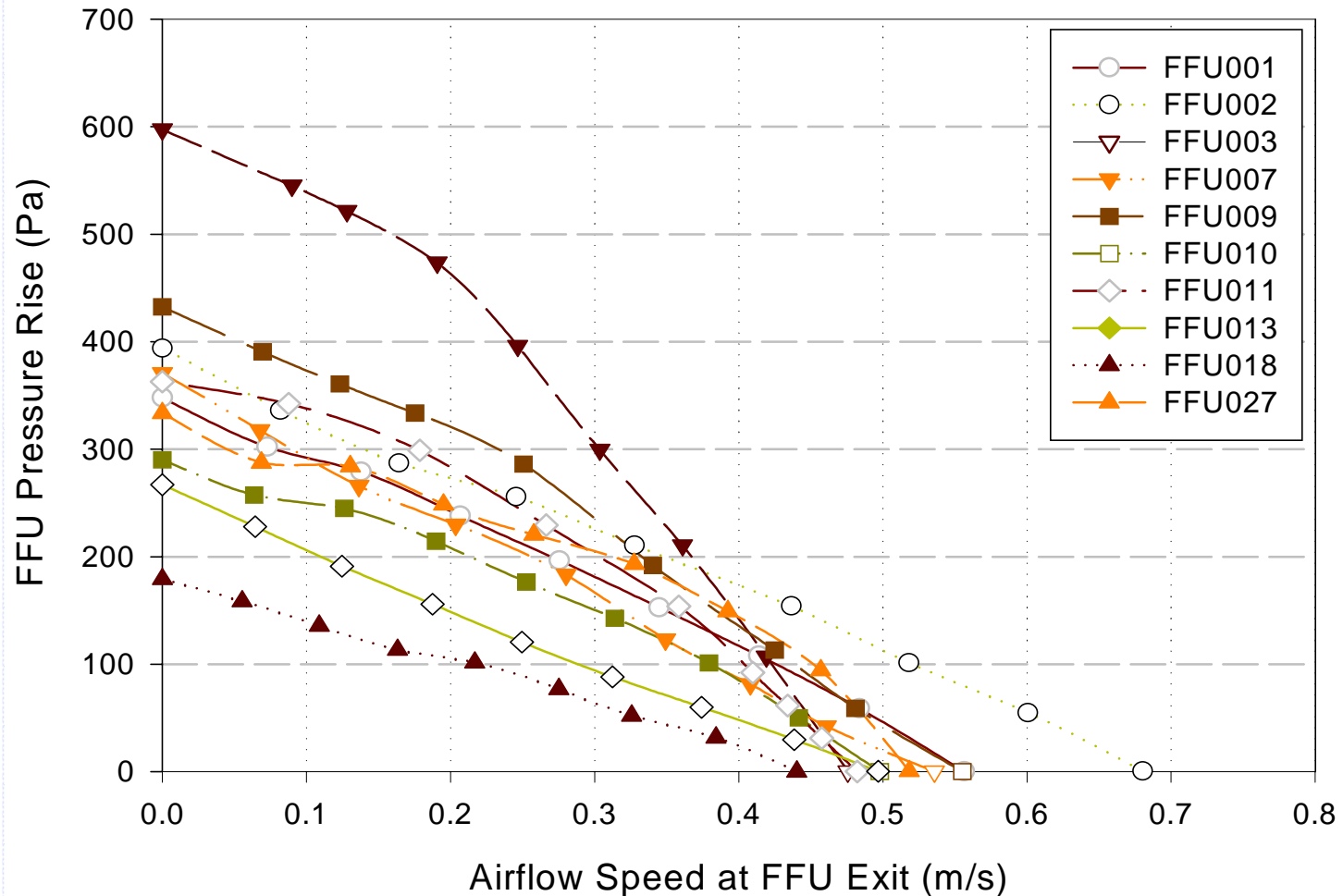
- ◆ Airflow control: booster fan & damper
- ◆ Airflow measurements: nozzles, hoods
- ◆ FFU orientation: vertical & horizontal
- ◆ Example:



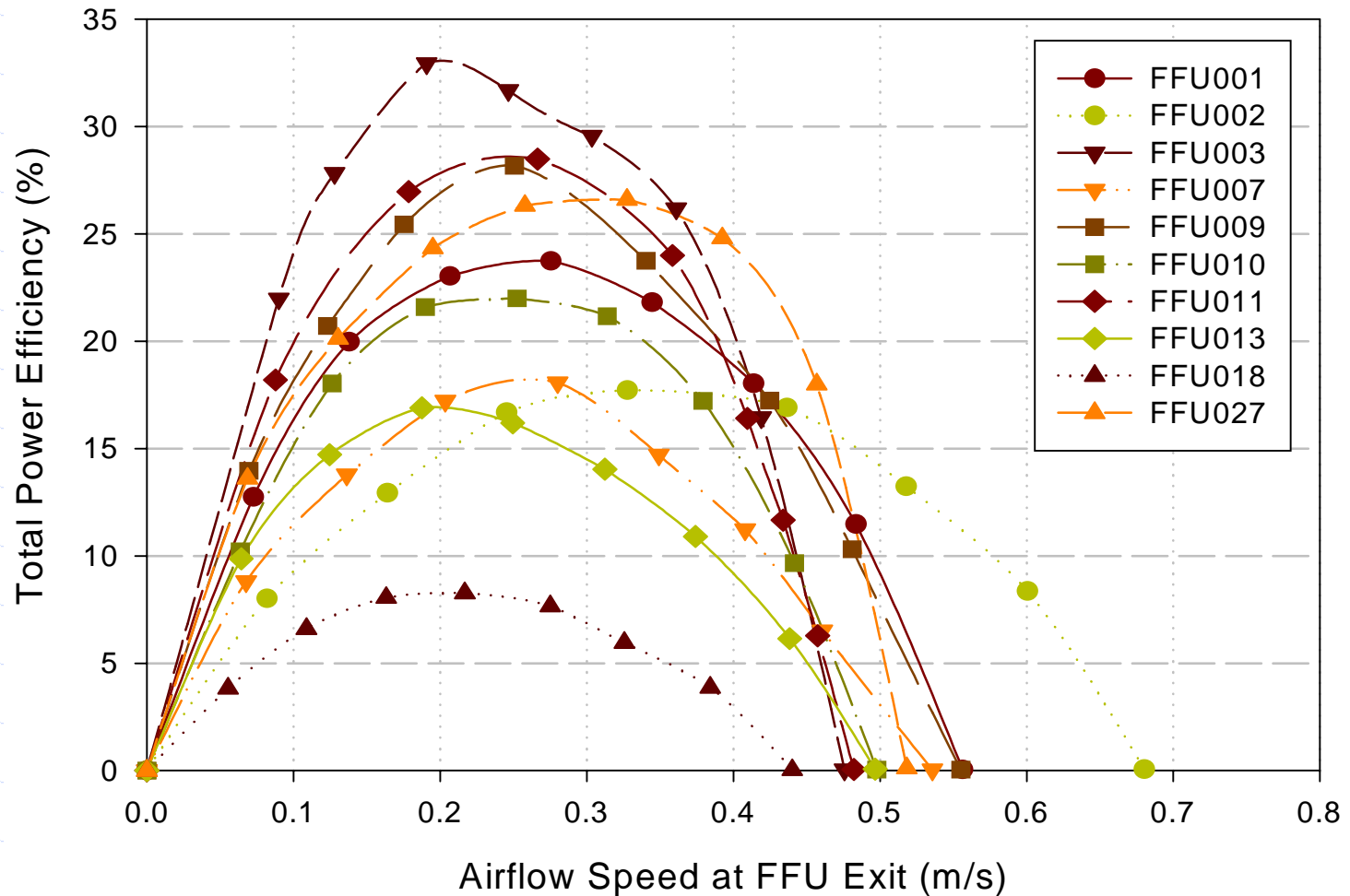
# Metrics

- ◆ FFU Total Pressure Efficiency (%)
- ◆ Energy Performance Index - W/cfm

Time (s)	Case 1 Pressure Rise (Pa)	Case 2 Pressure Rise (Pa)	Case 3 Pressure Rise (Pa)
0.0	380	380	380
0.1	580	410	390
0.2	600	430	390
0.3	580	420	380
0.4	550	410	370
0.5	520	400	360
0.6	500	390	350
0.7	480	380	340
0.8	460	370	330
0.9	440	360	320
1.0	420	350	310

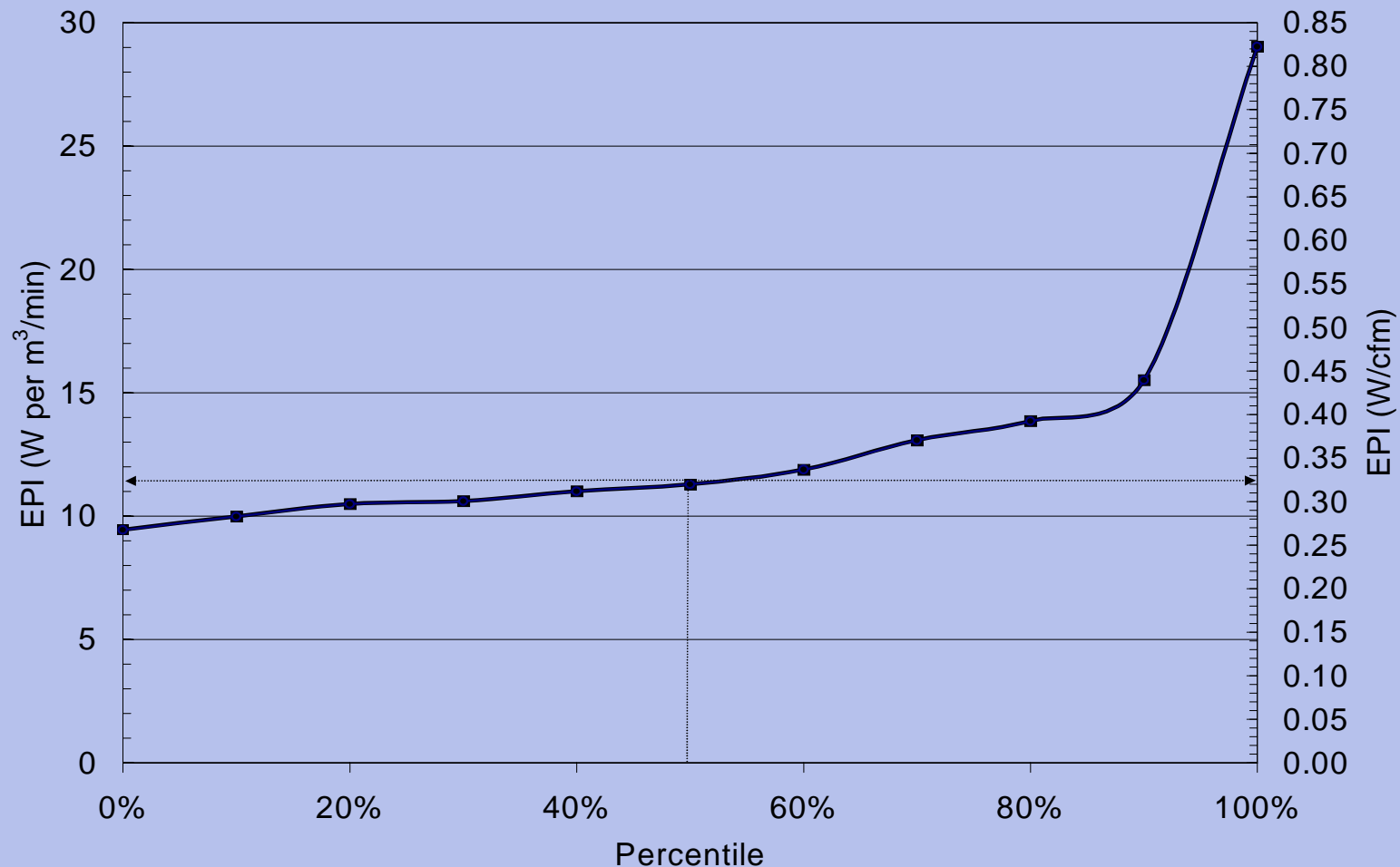


Method	Efficiency (%)
Proposed	35.5
Baseline	32.5
Reference	30.5



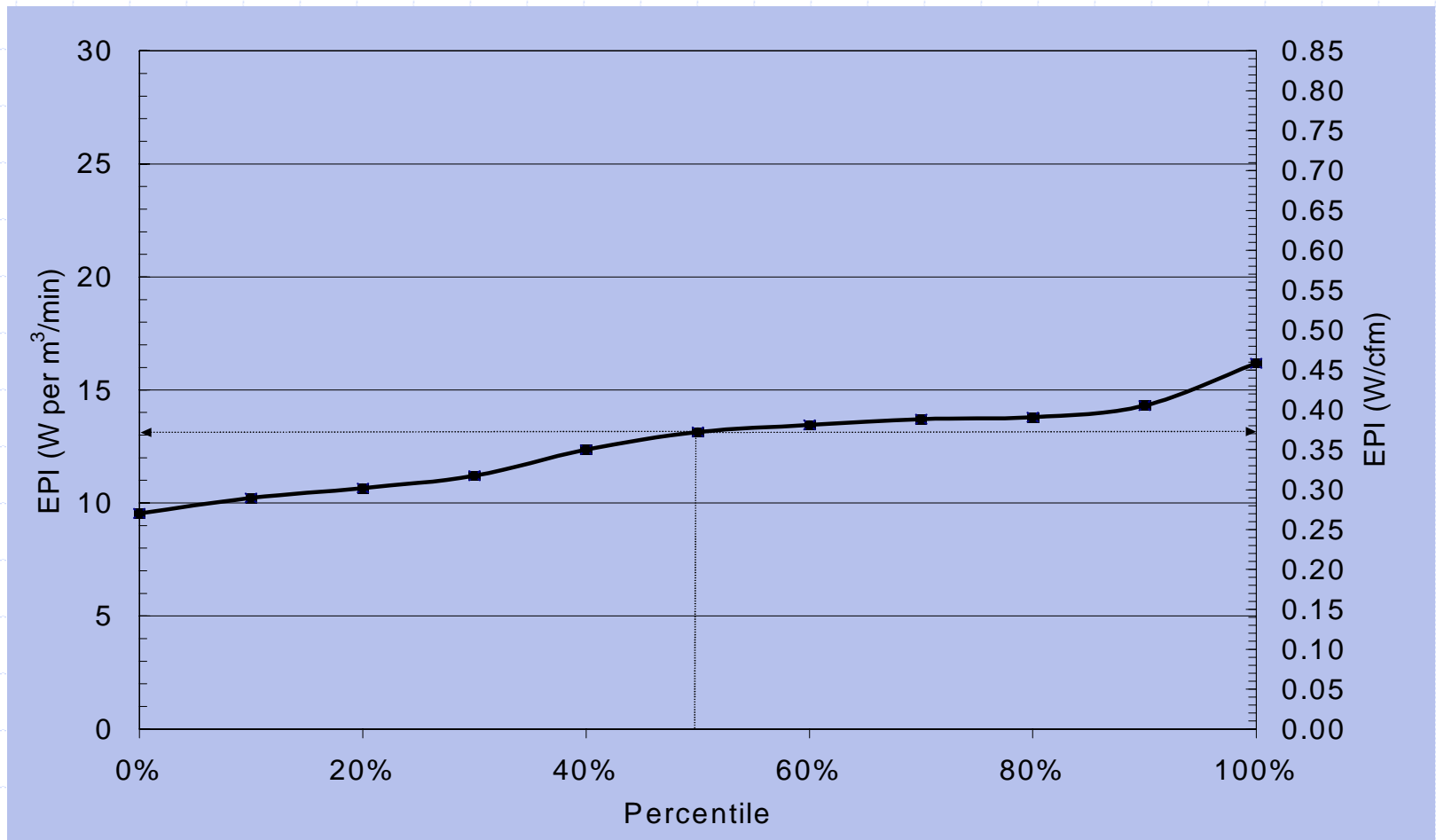
# Results

## - FFU Energy Performance Index W/cfm @ 0.5" Pressure



# Results

## - FFU Energy Performance Index W/cfm @ 70 fpm Face



# Industry Acceptance

- ◆ Presented/distributed draft procedures & results on Sematech Workshop
- ◆ A paper on test procedure and results received excellent peer-reviews and will appear in the Journal of the IEST 2004
- ◆ A paper abstract built upon the LBNL standard testing was accepted by STS: ISM (Innovative Semiconductor Manufacturing), and the full paper will be presented at SEMICON West 2004 in SF
- ◆ LBNL is working with utilities to formulate incentive programs for purchasing efficient FFUs

# Key Issues

- ◆ Additional parameters
  - Uniformity
  - Leak
  - Sound/Acoustics
- ◆ Airflow rate measurements
- ◆ FFU positions
- ◆ Baseline



# Recommendation to IEST WG Efforts

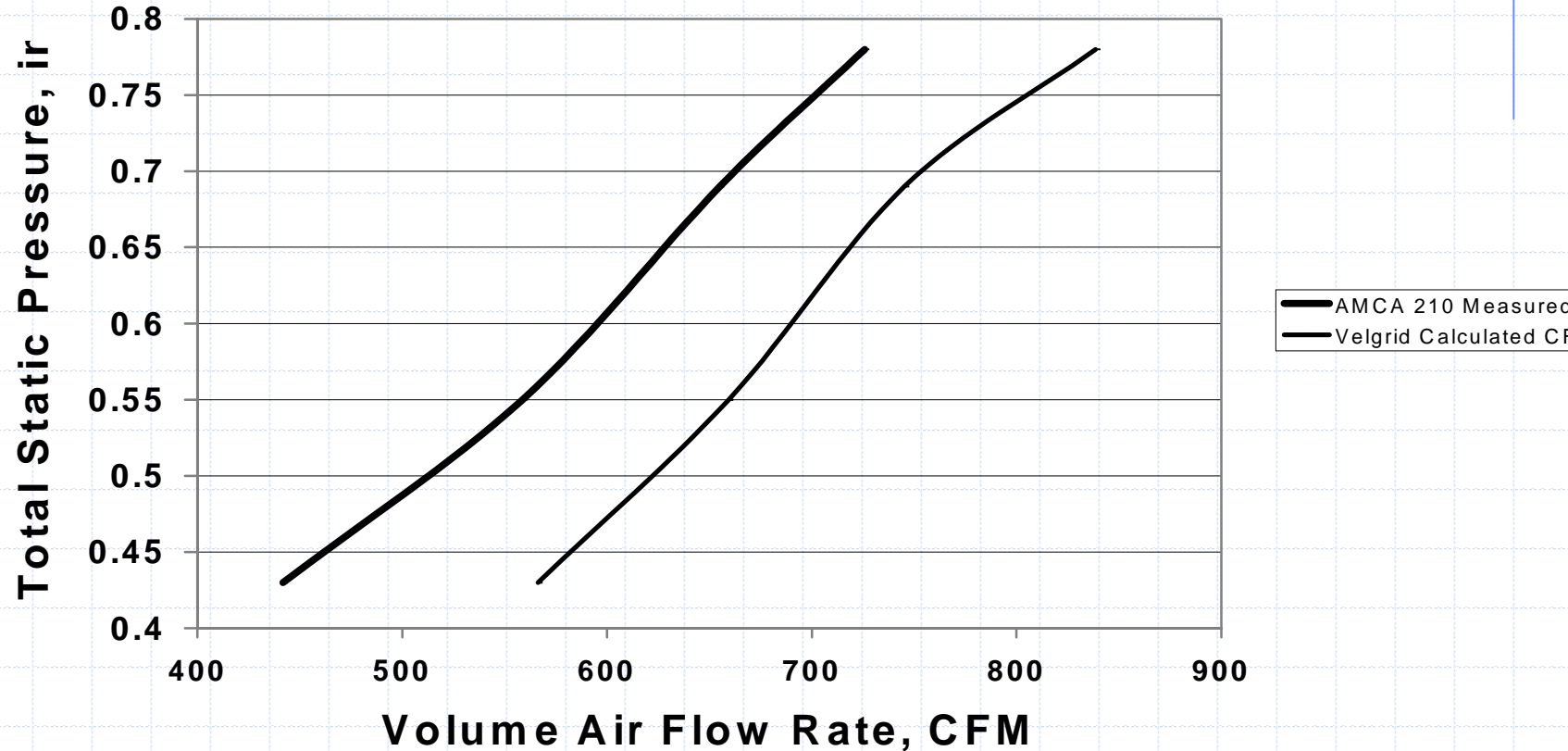
- ◆ Use the LBNL procedure as a starting point or at least use it as a reference
- ◆ Expand to include acoustics, uniformity, etc.
- ◆ Measurement methods of airflow rates
  - ◆ Accuracy is vital while easy to be mistaken
  - ◆ Must correctly report accuracies, e.g., 5%
  - ◆ Horizontal vs. vertical – need more data

# Airflow measurement

## Nozzle or Hood?

T

### A Comparison of Test Methods AMCA Test VS Velgrid Calculated



Source: Sematech workshop on minienvironment and FFU, April 2004

Produced by J. Hill, Cleanpak International

# Airflow measurement Vertical or horizontal?

Testimony: No difference for airflow rates

Source: Sematech workshop on minienvironment and FFUs, Austin, April 2004

# Input needed

- ◆ CA utility is interested in using the LBNL procedure to establish baselines for incentives
- ◆ FFU manufacturers encouraged to volunteer their units for testing

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